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Forthcoming Events.

MARCH 8.

Sheffield Metallurgical Association:—Ordinary meeting at Sheffield. "Cold Rolled Steel," Paper by G. R. Bolsover.

MARCH 9-10.

Institute of Metals:—Annual general meeting in London.

MARCH 11.

Royal Society of Arts:—Ordinary meeting in London. "The Iron and Steel Industry in India," Paper by Richard Mather, B.Met.

Institute of Metals (Swansea Local Section):—Meeting at Swansea. "The Influence of Oxygen on Copper and other Non-Ferrous Metals," Paper by F. Johnson, D.Sc.

Institute of British Foundrymen.

MARCH 5.

Birmingham, Coventry and West Midlands Branch:—Ordinary meeting at Birmingham. "Some Experiences in the Production of Malleable Castings," Paper by H. Field.

Lancashire Branch:—Joint meeting at Rochdale. "Cupola Practice."

THE FOUNDRY TRADE JOURNAL IS THE OFFICIAL ORGAN OF THE INSTITUTE OF BRITISH FOUNDRYMEN; THE WELSH ENGINEERS' AND FOUNDERS' ASSOCIATION, AND THE FOUNDRY TRADES EQUIPMENT AND SUPPLIES ASSOCIATION.

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Secretary: K. S. Bridges, Avenue Chambers, Southampton Row, London, W.C.1.

Narrowing the Margin.

Since the appearance of our last issue we have had the opportunity of discussing the matter of the importance of systematic costing with several prominent foundry owners, and a few engineering buyers. The former, in substance, state that they know their costs to within reasonable limits, but the engineers' buyers will not pay a remunerative price. The latter, however, tell a very different tale. They assert that the variation in quotations received from the various foundries is so great that as business men they are forced to rule out those falling into the higher priced category.

The cause of this considerable variation in prices, quoted by founders, must be attributable to either or both of the following causes: (1) Inefficient and incomplete costing, and (2) large differences in the general expenses of the business. Some of the old established foundries have annually depreciated the book value of their plant and buildings, until they now stand at almost zero. From an engineering point of view, this estimate may be too high, as the nature of the buildings and the obsolescence of the plant may be a direct hindrance to modern economic production, which insists that the buildings should be an integral portion of the plant.

Another adverse factor affecting the wide market price of castings is the installation by engineers of their own foundries, which, when slack, go into the competitive market against the jobbing shops. Large firms, actually some of the most important engineering works in the country, possessing large foundries, cut into the open market when orders are scarce, and quote prices which they must be aware are not remunerative. A further factor which enlarges the margin of prices quoted by foundrymen is due to the fact that some estimate on piece work and others on a time basis. It has been stated that only from 40 to 70 per cent. of the value of wages paid on straight time rate ever returns to the employer in the form of output.

It thus appears obvious that if stable conditions are to be reached in the jobbing—including the modern jobbing—foundry this large discrepancy in prices asked for castings must be narrowed. There are the following means open to the foundry owners of this country: (1) The acceptance by a very large number of foundries of a nationally accepted unified system of costing to be used as the basis for quoting; (2) appointment by districts of one common cost accountant to ensure that the full allowance for every cost item is being made; (3) the total elimination of waste of both labour and materials; (4) specialisation on the less competitive lines and the complete ignoring of inquiries for highly competitive work, and (5) merging. Finally, we would remind those who complain so bitterly of the excessive demands by engineers of the adage, "If you think you are beaten you are."

Correspondence.

[We accept no responsibility for the statements made or the opinions expressed by our correspondents.]

Heat Treatment and Growth of Cast Iron.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—The further work of Mr. Donaldson on "Heat Treatment and Growth of Cast Iron," which appeared in your issues of the 17th and 24th ult., interested me considerably. Mr. Donaldson is to be congratulated on the continuance of his investigations on this subject in a manner and style which he has made peculiarly his own.

The evidence for the decomposition of the combined carbon at temperatures considerably below the pearlite point may be considered now to be finally and fully confirmed as a result of this investigation.

There are one or two points of some importance to which I should like to refer. The first of these relates to Mr. Donaldson's conclusion (2) in which he states that "stability of the carbide is influenced . . . by the initial combined carbon content." I think this conclusion is hardly justified by the evidence, from which it might be sufficient to explain the difference in extent of the decomposition of the combined carbon by the difference in silicon contents.

This point appears to me to be of some importance in that there is a liability for foundrymen to be misled into believing that the amount of combined carbon is of prime importance, whereas it is really the silicon content that matters. There does not appear to me to be any *a priori* reason for assuming that the actual amount of combined carbon has any influence, and there is no evidence to show that in an iron containing 0.65 per cent. silicon that 0.45 per cent. combined carbon is any less stable than 0.91 per cent. carbon.

It is of considerable interest to me to note that the depression in the temperature strength curve makes its appearance in the "as cast" sample of Perlit Iron Pt2. This depression is, of course, both decreased in magnitude and temperature. Whilst the exact cause of this depression still remains to be investigated, from my own views as to its cause I had half expected to find it absent in Perlit Iron. I should like to express the hope that in continuing his investigations Mr. Donaldson will devote some attention to elucidating the cause of this depression.

Finally, I notice Mr. Donaldson refers to the "carbide decomposition." It is only a very small point, but I should like to direct Mr. Donaldson's attention to the fact that it is just possible that this decomposition may be found to be of something different from what we understand as carbide. For this reason I think it preferable to refer to these phenomena as the "decomposition of the combined carbon."

In conclusion, I should like to express again my appreciation of this further contribution of Mr. Donaldson to the study of the Heat Treatment and Growth Phenomena in Cast Iron.—I am, Yours, etc.,

J. E. HURST.

Newton Chambers & Company, Limited.,
Thorncliffe Centrifugal Casting Dept.,
Nr. Sheffield.

Alloy Cast Irons.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—May I draw attention to a slight error in the reproduction of my letter on Alloy Cast Irons printed in your issue of February 17? Lines 31-2-3 read:—"—— and occur at such temperatures that the metal structure is relatively rigid, hence the pro-eutectoid-cementite. Graphite will not be able," etc. They should read:—"—— and occur, etc., etc.—hence the pro-eutectoid-cementite graphite will not be able—— "

The reference is to that graphite which is formed by the splitting up of the pro-eutectoid-cementite. I know you will appreciate the point, and trust you will be good enough to correct the error, for which I am probably to blame.

Yours truly,

F. D. CORBIN.

181, Tyrfran, Llanelly, Carmarthenshire.
February 21, 1927.

American Conditions.

To the Editor of THE FOUNDRY TRADE JOURNAL.

SIR,—I have read with great interest your leading article, and also the early history of the I.B.F., published in your issue of February 17, and, although agreeing that great progress has been made in the foundry trade since the inception of the Institute, it is certainly forcibly apparent that little or no advance has been made with regard to sand mixing and mechanical handling plant. The backwardness of the British foundrymen, and also the British suppliers of the foundry plant, is all the more noticeable when one studies American conditions.

I did not have the opportunity of attending the Detroit Convention last year, but it would certainly be interesting to know the views of some of the members who did, on the conveying system and sand-mixing plant, which, as one gathers, are installed in at least 90 per cent. of the American foundries, and yet in England one would have to go a long day's march in endeavouring to find a foundry so mechanically up to date as in America. It may be that I am rather ignorant of the progress made in some English foundries, but at the same time it is certainly striking that, if there are manufacturers of the mechanical conveying plant for foundries in England they have not yet learnt the art that it pays to advertise in those periodicals which are read so largely in foundries, and it certainly seems that our American friends are far ahead of us, and there is still room for vast improvement, which the I.B.F. can tackle with greater energy than it has done in the past.

Thanking you for allowing me space in your excellent journal, and trusting that I may receive some enlightenment, yours, etc.,

ENTERPRISE.

Yeovil.
February 25, 1927.

[Both Mr. Russell and Mr. Jolley have dealt in articles with this phase of American practice. Probably, the layout of the Midland Motor Cylinder Company is better than the majority of American layouts. The sand-preparing plant delivers the sand in side-tipping wagons drawn by electric locomotives running on a gangway situated at the crane level outside the building. The wagons tip their load down chutes, which terminate above the moulding machines. All the main movements inside the foundry are carried out by conveyors or overhead crane power.—EDITOR.]

Institute of British Foundrymen.

Lancashire Branch, Junior Section.

The annual social of the Junior Branch of the Lancashire Section was held on Saturday, February 26, at Winn's Café, Manchester, the President, Mr. W. Jolley, in the chair. There were also present Mr. S. G. Smith, the Branch-President, Mr. R. A. Miles, Past Branch-President, Mr. Village, secretary of the Sheffield Branch, and Mr. T. Makemson, the General Secretary.

In a short address the Chairman advised apprentices and youths in the foundry to carry their troubles to the foreman, and not to be afraid of making suggestions when it appeared to them there was good reason. Sometimes an apprentice might observe something which escaped the notice of more experienced people. They should also remember that while in the works they saw a great deal of one side of a foreman's character there was another side which was worth knowing, and that was the social side. It would be a good thing if they could get their foremen to come to gatherings of this kind. At the same time technical training was all-important and the foremen of the future would be men who had learned to use their brains as well as their hands.

An entertainment was given by Capt. Jackson, and Messrs. Hayes, Lamb and Gray. A youthful member of the Section, Mr. G. Ward, added violin selections and Mr. Key was among the vocalists.

A vote of thanks to the artistes was passed on the proposal of Mr. R. A. Miles.

A Foundry Costing System.

By A. W. G. Bagshawe (Managing Director, Messrs. Bagshawe & Company, Dunstable).

(*Continued from page* 165.)

There is no need to have a limited small number of entries like those shown in Fig. 4, but the charts have been kept as simple as possible for the sake of simplicity.

For instance, instead of one item for pig-iron, there is no objection to three or four items for pig-iron. Each item will, in that case, presumably cover a different grade or different make. A separate item can be kept for bought scrap. No useful purpose can be served by keeping any item for runners and foundry wasters, which are melted in due course. It is advisable to include the tonnage of such runners and foundry wasters in stock when stock is taken, and they can in that case be valued at the average price of pig-iron. The same remarks about sub-division may be applied to sand, abrasive wheels, as already explained, and any other items desired.

Internal Transport.

Carting is an item which has to be dealt with in a rather different way, and may include actual carting and internal transport as well as unloading railway trucks. There is no objection to dividing it into several headings. Actually it is better to take the average cost of core shop materials per ton of castings produced. In many cases probably a little commonsense would be sufficient to consider what extra cost is incurred, where cores are required and where cores are not required. Supposing that the average cost of core material per ton of castings is 5s., it is obvious if there are no cores in the castings the average cost per ton is 5s. below the normal. If, on the other hand, you have to make castings with fairly large cores it will be necessary to make a guess and suggest 10s. in that particular case.

The author does not visualise any difficulty in calculating the cost of a cubic foot or cubic inch of core sand which should include the cost of driers and other materials such as binders used in that department. This figure, which should only be a small fraction of a penny, could be used in estimating by working out the cubic inches of the cores used. It has never been found necessary to go to this amount of detail, and a reasonable amount of guessing in estimating core material has proved sufficient for practical results.

It is, however, thought that it can be easily arranged in the case of very large cores where

FOUNDRY		DATE		NAME & Nº				5
Nº 1		21 Jan 26		A Jones 104				
ORDER	PRICE EACH	NUMBER MOULDED	NUMBER GOOD.	WEIGHT GOOD	WEIGHT SCRAP	PAY s	PAY d	REMARKS
10432	4"	38	37	296	8	12	4	
10561	3½"	18	16	104	13	4	8	
10201	1/-	3	3	42	-	3	0	
10656	-	2	x	x	x	1	6	Samples for test
TOTAL.				442	21	21	6	

FIG. 5.—MOULDER'S PAY CARD.

do so. In both cases a record will have to be kept of the wages spent or if the job is let to a sub-contractor, the amount paid to that sub-contractor. If a foundry does its own carting a record will have to be kept of the cost of keeping horses, or in the case of power trucks being used the cost of petrol or electricity.

Motive Power.

In the case of power, one of two possibilities may occur, or a combination of both. The works may make its own power or it may buy it. If it buys it, it is only necessary to take the cost from the supply company. If the works makes its own power, the cost of fuel or oil must be recorded, also the wages.

In some large works, it may be considered an advantage to take the actual power consumption of each section of the foundry. For instance, the pattern shop—the sand preparation and melting, the cupola—fans or blowers, the grinding shop—the sand blast, if used. This is not an easy matter unless the works is electrically equipped. If the works is electrically equipped, there is not much difficulty, as meters are not very costly items, and one can be installed for each department.

Core Sand.

Core sand and other material purchases for the core shop present a certain amount of difficulty, as cores are not used in equal quantities in all castings. Actually, of course, many castings have no cores at all. The best method appears to be to a considerable quantity of material is required if necessary. It is useful to number the various accounts. The account numbers are shown in the left-hand column (Fig. 4). They are not necessary, but they save much time in referencing and help to save mistakes. The third column (Fig. 4) gives the total tonnage for the year, whilst the fourth column gives the total expenditure for each item, and is obtained from separate cost record sheets similar to the pig-iron and abrasive wheel sheets which have been shown.

The fifth column (Fig. 4) is for the cost per ton of each item, and is obtained by dividing the amounts in the third column by the tonnage made, in this case 2,256 tons. The total at the bottom gives the expenditure on materials in this group for the year, and the average cost per ton. With the exception of core sand, which is somewhat special, it will be agreed that all of these items will vary very little with the tonnage of the foundry. It is true that a foundry buying large quantities of material will naturally buy somewhat more cheaply than a foundry buying small quantities. That figure will not, however, make any difference to the average cost if the foundry happens to be busy for two or three months and then slack for two or three months.

The author has always found that many of the troubles in operating a system of this kind can be avoided by having a very large "remarks" column, which can be used to deal with the great number of small contingencies that occur, and for any other remarks of interest and comparison.

Variable Costs.

Referring to Fig. 1, it will be seen that the variable costs are nearly all labour items. It is quite easy to find two castings of somewhat similar size and weight which customers may expect to buy for the same price per cwt. Any foundryman knows perfectly well that one of these castings may be very much greater in cost to produce than the other. The difference in cost can be attributed to a variety of reasons, the best known are moulding cost, core making, fettling, and finishing. When these operations are considered, the difference in cost comes down very much to a question of labour, and it is for that reason that the majority of these headings under the "variable cost group" are labour accounts.

In dealing with these labour accounts, there are two distinct kinds of information to be obtained:—(1) The general or average cost of moulding per ton of castings produced; and (2) the actual cost of moulding of any particular casting or number of castings from the same pattern. The same remarks apply equally to core-making, grinding, fettling, etc.

Fig. 5 is intended to represent a moulder's pay card. In the case of a foundry casting every day, a separate card should be issued to each moulder every day. If the firm only casts two or

WEEKLY PAY CARD. 12

WEEK ENDING	NAME & Nº
23 Jan 1926	A Jones 104

DATE.	AMOUNT £	s	d	REMARKS
17 Jan		18	7½	
18 Jan		19	4	
19 Jan		11	2	
21 Jan	1	1	6	
22 Jan	1	2	1	
23 Jan		18	5½	
Total	5	11	2	
Deduct Insurance		1	4	
Net	5	9	10	

Fig. 6.—Moulder's Weekly Pay Card.

CORES. DATE 21 Jan 1926 NAME & Nº A Smith 203 6

ORDER	PRICE.	NUMBER REQUIRED	NUMBER GOOD	PAY s	d	REMARKS
10673	4° ea	20	18	6	0	Main Body Core
10941	½°	110	106	4	5	
10521	1/6	1	1	1	6	Top Core
11718	1/4	2	2	2	8	Barrel
10673	1°	20	19	1	7	Flat
10673	¼°	40	40		10	End Core
10673	4°	2	2		8	Main Body Core
				17	8	

Fig. 7.—Coremaker's Pay Card.

three times a week, it may be sufficient to issue one card for each cast. The card should be large for satisfactory work. The author uses cards about 11 in. long by 5½ in. wide. For convenience in distribution, the cards for each department are differently coloured. For instance, the moulders' cards are white. The pattern cards are pink, the core cards are blue, the grinders' cards are yellow. The names on the cards can, if the quantity justifies it, be put on very quickly with an addressing machine of some kind or other. The most convenient method is to make out the whole week's cards at one time. On the left-hand side the order number is given, in the second column the moulding price for the casting, which may vary from anything from a fraction of a penny to some pounds in a foundry dealing with very large work. It is assumed in this case that the card is totalled at the bottom, and the cost-recording side of the question then commences. Before going into that question, attention is again called to the margin, which is obviously very useful.

A casting may be lost through no fault of the moulder. The iron may not be as fluid as it might be, or a core may be defective, or something else may be wrong. In that case an allowance should be made to the moulder, and the remarks column is the proper place to record such information. On this particular card a sample for testing purposes is shown. This item, in this case 1s. 6d., should be transferred in due course to the cost account, so that the total cost of testing castings for soundness, for instance, is known at the end of the year. This figure is usually a very small percentage of the total cost, and

PATTERNS	DATE	NAME & Nº	7
	21 Jan 1926	R White 151	2/-

START h m	TOTAL TIME h	m	ORDER	VALUE s	d	COST ACCOUNT	REMARKS
7-30	2	15	11123	4	6	x	
9-45		20	11079		8	21	Varnishing
10-5		40	19092	1	4	24	Repair Core Box
10-45	1	15	11123	2	6	x	
1-0	2	30	11310	5	0	x	Alteration
3-30	1	30	11123	3	0	x	
5-0	Out						
Total	8	30		17	0		

FIG. 8.

foundry is like most of them, working on a piece-work basis. If a time-work basis is used, a similar system can be used, but it is somewhat more complicated; at the same time, it is not beyond the ability of anybody to work out a satisfactory arrangement if he wishes to do so. Complication occurs through the time lost in casting and cleaning up after casting. In the third column (Fig. 5) the number of castings moulded is recorded just before the cast. Should an insufficient quantity of iron be charged to the cupola, and a certain number of the boxes not be cast, this figure should be altered directly the cast is finished.

The next column is filled in probably the next day after the castings have been inspected. It gives the number of good castings produced by the moulder.

The next two columns give the weight of good castings and scrap castings. As scrap castings are not always sent from the foundry to the inspection department, it is not always convenient to weigh them, and it is very often, therefore, easier to calculate the weight of the scrap rather than actually weigh it.

The last column, of course, the most important one from the moulder's point of view, gives the actual amount of money earned by him. The may well be treated as an average on the cost of all castings produced.

Having obtained the moulder's earnings for a day, it is then necessary to see that they are recorded, so that he receives his wages in due course at the end of the week. For this purpose, a weekly pay card (Fig. 6) is used, on which each day's earnings is written down, and totalled at the end of the week, with the insurance deducted. The card should be given to the man some considerable time before the wages book is finally completed, so that any disputes may be settled in good time. For the purposes of the wages book all that is necessary is the total at the bottom of the weekly card. The pay for each individual day is not of any value to the wages book.

Core Shop Cards.

This (Fig. 7) is a similar card to the moulding card (Fig. 5), and is dealt with in exactly the same way. The "remarks" column here is very useful for identifying different types of cores used on the same castings.

Pattern-Shop Labour.

The pattern-shop card (Fig. 8) is somewhat different, as pattern shops are generally run on a time-work system. It is, therefore, essential that

the time for doing work is recorded against each order number.

The author favours recording only the starting time for each job, but there is something to be said in favour of the system of recording the starting and stopping time, as there is a liability to lose time between any two jobs. In this particular case, the total time on any particular job is obtained by deducting the starting time on that job from the starting time on the next job. The starting time is put on the left-hand side, as that is the most convenient position for registering on the time clock. The order number in this case goes in the third column, and the value of time spent on the job in the fourth column. The man's rate per hour is shown in the top right-hand column. It is, probably, advisable that this rate shall not be shown on the card when it is issued to the shop. If a time clock is used, it is better to have the cards kept near the clock, as there is less liability of their being lost, and they can always be quickly referred to by the man in charge of the department. Under those conditions, if the rate of pay is shown on the card, it appears rather unreasonable that a competent man's rate of pay should be known to every odd and sundry person, who has the curiosity to examine the card. For this reason it is suggested that the rate of pay should not be shown on the card until it is returned to the costing department for recording.

Apart from the question of the cost of special patterns made to customers' instructions there are in a pattern shop always a considerable number of small incidental jobs which have to be done, such as repairs, re-varnishing of patterns, and repairs of core boxes. Many of these items are small, and the author has always found it most convenient to keep a set of cost sheets to deal with these matters. For convenience they are numbered, but it is recommended that the selection of these various accounts be left to someone responsible, who is capable of making a reasonable selection of the right account. The total pay at the end of the day should be recorded on the weekly time card.

At this point it is advisable to say that, after these various cards have had the necessary information extracted from them, they ought to be returned to the men to do exactly as they like with them, particularly in the case of piece-workers; otherwise, some kind of a duplicate must be kept, as it is essential that they shall have a fully detailed record of what they are earning from day to day.

To return to the moulder's card (Fig. 5). After the total wages for the day have been entered on the weekly pay card, there are three other jobs to be done by the cost department. They are:—(1) The total weight—good and bad—requires recording. From this, such incidental information as the average percentage of good castings may be taken; also, the percentage of good each man makes over, say, a month could be obtained. This figure must be used with discretion, as some of the best moulders are frequently given the most awkward jobs on account of their superior experience, and are, therefore, justifiably liable to make a bigger percentage of waste than the average of the shop; (2) the total of the pay of all the moulders for the day; and (3) the recording to each individual order cost sheet of the amount spent on that order, that is to say, on the cost sheet for order 10432 the amount 12s. 4d. has to be recorded on the cost sheet for that individual order. It is also exceedingly useful to record the number moulded and the number good. In addition, any special items, such as samples, require transferring to their correct summary sheets.

Having obtained in our various departments the total amounts paid, these totals should be transferred to a collective sheet, or series of separate sheets, if desired, which show the expenditure in wages in each department every day.

(To be continued.)

One furnace has been put into blast at the Oldside Works at Workington, and will shortly be producing ferro-manganese. The United Steel Companies have now five furnaces in blast at Workington, two each at the Moss Bay and Derwent Works and one at Oldside.

Pattern Making and the Foundry.

An informal discussion on the subject of "Pattern Making and the Foundry" took place at the meeting of the Birmingham, Coventry and West Midlands Branch of the Institute of British Foundrymen, held at the Engineers' Club, Waterloo Street, Birmingham, on February 17. The Branch-President (Mr. D. H. Wood) was in the chair.

The President expressed regret at the small attendance, and the fact that Mr. F. C. Edwards, who was announced to open the discussion, was not present. In his absence, he said, Mr. W. J. Flavell had kindly consented to introduce the subject.

Mr. Flavell claimed that pattern making required more skill than any branch of the engineering trade, and said it was essential that there should be a good understanding between the pattern-making department and the foreman moulder. Cases within his knowledge where the relations had not been satisfactory resulted in a great deal of friction and consequent wasters. His experience was that there was a great deal of difference in the mentality of pattern makers. Some delighted in an intricate job; others, if given such a job, would very likely suddenly develop an attack of the 'flu. (Laughter.) The same observation applied in a great measure to moulders. Some delighted in an intricate job, while others were not happy unless they had a 7- or 8-ton casting, either loam or green sand. In the case of motor work, the pattern was made so simple and everything made to go together so nicely, that, so far as the foundry was concerned, it was practically only a case of ramming up. It was otherwise in the case of wheel work and gear work, where a man needed to be well qualified or his job and to put the utmost ability into it.

Mr. E. J. Lewis agreed as to the high skill required in pattern making, and said it was very seldom a man was forthcoming who could tackle any job. They had to do in the pattern shop the same as in the foundry—choose the man to do certain classes of work. To overcome differences between the pattern shop and the foundry he suggested the appointment of a governing head who had the ability and the power to say "We will have it this way." He must know both trades. Such an appointment, he believed, would save a great deal of friction between the two departments. While giving the pattern shop full credit for its technical skill, he could not agree with Mr. Flavell that little skill was required in the modern foundry.

Mr. Flavell: I did not say that. I limited my remark to certain jobs.

Mr. Lewis contended that in the case of a motor cylinder, after the pattern maker had exerted all his skill, there was still a great amount of skill necessary on the part of the moulder. No matter how clever a pattern might be, wasters would result unless it was entrusted to an efficient man. It was not only in the moulding that skill was required, but in deciding what kind of sand was to be used in the cores, especially in cylinder work. Another factor in success was the cleanness with which the air was got away from the cores. Much of the difficulty was caused by the man who bought the pattern. Many thought they could obtain a £100 pattern for £15 and expected the same results. He did not think pattern makers were paid in accordance with their ability. It must be remembered that a pattern maker very often spent £50 on a kit of tools, and had to be continually adding to it, while he was paid less than a road sweeper.

Mr. J. B. Johnson considered that the highest skill was to be found in the jobbing shop, where men had to turn their hands during the twelve months to practically every class of work.

Closing the discussion, the President said it appeared that the pattern maker must have the imagination of an artist or novelist, the skill of a highly-trained engineer, the versatility of a jack-of-all-trades, and in return must be content with the wages of a dustman. There was also a considerable discrepancy between the wages of the ordinary moulder and moulders working on machines.

Principles of Testing.*

By H. R. Pitt.

In the preceding Paper the author is engaging in an endeavour to formulate the best methods of determining the mechanical properties of cast iron and applying, as far as may be possible, recognised principles and methods of testing to the measurement and assessment of its physical values.

It is necessary to effect this object to take into account, as fully as possible, the special properties and peculiarities of cast iron in order that results of tests may be given their true values both individually and relatively. Further, to see how far the results arrived at may be relied upon as giving indications of the behaviour, or capacity to sustain loading or stresses under conditions of service.

Established and recognised tests are often regarded as giving an absolute value in the shape of a figure which represents the safe loading limit of the material, but as stresses are seldom either single or direct, the importance of understanding and allowing for weaknesses in one direction while testing in another cannot be overrated. Thus methods of testing are capable of criticism or present the need of special adaptation making it incumbent upon those handling the tests to take precautions or use special appliances to obtain useful and effective results and figures.

Difficulty of Appraising the Value of Cast Iron.

In the case of cast iron, one is confronted with a number of factors which are its special peculiarities, no other metal presenting so varied a constitution or so many physical possibilities, such wide limits of strength and weakness within the same limits of its normal manufacture. In the matter of chemical composition its complexity is very involved leading to a great range of possibilities in directions affecting, if not governing, its physical behaviour.

As a metallurgical study, cast iron can be said to be extremely complex and diversified. Effects of carbon content alone form a comprehensive study, the effects of silicon, sulphur and phosphorus further complicate its physical and mechanical properties almost *ad infinitum*. In such a metal, it is not remarkable that great and numerous difficulties arise when its properties become the subject of measurement by means of processes mainly devised for other metals of simpler constitution and possessing a degree of elasticity or plasticity rendering them more easily adapted to the application of measured forces.

Testing High Duty Irons.

Yet another aspect of testing has been brought into being by recent improvements in methods of production following on a fuller knowledge of the constitution of ferrous alloys enabling a finer degree of control of quality in production and resulting in cast irons of greater strength, higher endurance, and generally enhanced properties.

These higher class materials require testing on a plane which will permit of discrimination between varieties made by different processes and endowed with properties not usually associated with the cast iron known in earlier days, and the process of research into the properties and behaviour of these irons necessitates departures from stereotyped methods and the fullest knowledge of the value of such methods of evaluation as may be employed.

It becomes, therefore, of supreme importance to place the testing of cast iron upon such a footing as will ascertain and define its physical qualities and to employ testing methods which will determine and demonstrate its properties with accuracy and precision.

There can be little doubt but that the future will bring increased demands for engineers and designers for high-duty irons to fulfil specifications involving higher test figures with a better assurance of their performance in service.

It is proposed, therefore, briefly to consider the axioms and first principles of testing, and endeavour to adjust their application to a metal which while possessing many valuable properties is not credited with those which are the primary qualities of all those numerous metals and metallic alloys whose utility is based upon ductility, malleability, forgeability and plastic or elastic qualities.

An Unappreciated Heritage.

Testing appliances and equipment generally has grown up around steel and wrought iron, and it is unfortunate that the methods and devices admirably suited to these metals are usually called upon to serve for cast iron testing, and the writer can quote many instances from his own experience where test results quoted with confidence have condemned material which further investigation proved to be well up to the strength which was claimed for it and the original conditions of the test shown to have subjected the test pieces to important strains other than those indicated by the measuring instruments employed.

Basic Desiderata.

In any attempt to demonstrate or determine the physical qualities of a material it is required to know—(1) What properties to test for; (2) how best to measure those properties; and (3) how to interpret the results obtained and how to embody the results to achieve safety in design and endurance in practice. It is further of great service to be able to correlate the figures from two or more different tests.

The necessary equipment demands:—(1) The provision of suitable test pieces and test bars which must be representative both in condition and treatment of the material to be tested, and (2) the necessary testing machines and measuring instruments.

Roberts Austen, in his early but invaluable "Introduction to the Study of Metallurgy," quotes the essentials of mechanical testing as follows:—In determining the strength of metals it is necessary to determine: (1) The greatest stress the metal can sustain within the limit of elasticity; (2) the strain within the limit of elasticity; (3) the total extent of the strain or alteration of form before rupture takes place, and (4) the ultimate tensile strength or maximum stress the material can sustain without rupture.

Obviously the above conditions demand a special interpretation in their application to cast iron: thus in No. 1 and No. 2 the stress obtained is in tension, virtually the fracture point of the metal, while under a transverse load the elasticity as measured by the deflection does not indicate with any degree of definition any point which coincides with the yield point of the metal (*i.e.* no point at which with a stationary load, the deflection noticeable increases).

In tension, the yield point and breaking load of cast iron are usually said to be the same, because the bar fractures almost immediately it changes its form, certainly before any elastic interval can be observed on a gauge.

Theory of Transverse Testing.

By common acceptance, the transverse test on a bar 2 in. × 1 in. on a 36 in. span has become the standard test for cast iron and will probably remain so, though the tendency now is to favour a round bar of varying diameter, according to the size of section prevailing in the casting, in place of the rectangular or square bar which has been in vogue in this country.

The whole principle of transverse testing is based upon the accepted theories and formulæ determining the strength of beams. These laws though appearing straightforward present some complexities, and especially when on operation upon material of the nature physical and structural of cast iron.

For this certain assumptions are necessary, among which are:—(1) That the beam is symmetrical about a certain longitudinal plane, which

* A Paper read before the Birmingham Branch of the Institute of British Foundrymen, Mr. F. J. Starr presiding. The Author is associated with Messrs. Green of Wakefield.

plane alone is subjected to the loading; (2) that the beam is initially straight, and (3) that the beam is of material homogeneous and perfectly elastic.

These and other purely mathematical considerations have the effect of making a cast-iron test bar cast under ordinary conditions in a foundry appear rather a rough-and-ready member.

They will, however, emphasise the importance of making the bars within reasonable limits of size and correctness of form a fair degree of skill in moulding, casting at the necesary temperature to secure the maximum of homogeneity and freedom from defects, also under conditions in all respects similar to those which produce the casting or castings it represents.

Results Chaotically Expressed.

The standard sizes of bars for transverse test vary in different countries, and this, coupled with the different systems of weights and measures in vogue, leads to some considerable confusion in comparing results under one system with those of others.

The best-known standards are:—

British.—(Accepted), 2 × 1 in. on 36-in. span, load being expressed in cwts. and deflection in inches, and (proposed) 1.2-in. dia. on 18-in. span, load being expressed in pounds and deflection in inches.

German.—30-mm. dia. on 600-mm. span; load expressed in kg. and deflection in mm.

American.—1½-in. dia. on 12-in. span; load expressed in pounds and deflection in inches.

Keep's test, largely used, employs a bar ½-in. square and 12 in. long, and there are other sizes prescribed by different authorities and quoted in their specifications.

Necessity for Common Basis.

It becomes evident in viewing these various dimensions and standards that the need for standardisation is very pressing. Not only are sizes and systems of measurement so varied as to bring into test results factors of uncertainty in regard to their comparison, but when in vogue for cast iron, with its high sensitiveness and susceptibility to outside influences, comparisons become either impossible or valueless. It is further a matter of great difficulty to visualise quickly results in one system when expressed in terms of another, and in so far as it is feasible to assess one test value, as, for instance, the estimated tensile from the determined transverse strength, the possibility fades away when the original values are veiled in a system which is unfamiliar.

Modulus of Rupture as Solution.

These and similar considerations have prompted many investigators to inculcate a method of bringing these tests into line by the establishment of a test figure independent of the size of section which would definitely express the transverse strength and general physical capacity of cast iron.

The modulus of rupture figure as a method of expressing this has grown in favour of late, and with certain modifications it can be looked upon as a solution of the problem.

These modifications concern the interpretation likely to be put upon the results in actual practice, as in design the size of section employed in relation to its modulus of rupture looms into considerable importance, and it must be guarded against that, in employing cast iron, the modulus is a safe figure for calculation of strength in any size of section.

Modulus of rupture is explained in tons per sq. in., or in Continental mode kg. per sq. mm., and, in brief, it is a figure expressing the strength calculated from the modulus of the section and the distance between the points of the span. It is always simple to obtain the modulus of rupture where one size of bar only is concerned, as with each diameter and span the factor is the same, thus the modulus of the section of the proposed standard bar 1.2-in. dia. on 18-in. span is always 0.0119.

In varying sections of odd sizes considerable mathematical calculations are involved in arriving at the modulus of rupture, but results can be more readily arrived at when only the 2 × 1-in. bar on a 36-in. span and the round bar of 1.2 in. on 18-in. span are concerned.

It is, however, impossible to accept the modulus of rupture figure without any consideration of the size of section, for it must be remembered that the relation between small and large sections in cast iron are not regularly progressive in their breaking loads, and thus the initial factor becomes a variable one.

It therefore seems that standardisation must follow its old accepted course and that no such figure of merit is practicable; indeed, it seems to be recognised that such is the case as in specifications, especially those of important castings, both transverse and tensile strengths are required. There is likewise a growing general demand for tensile strength to be quoted commercially.

Inter-Relationship of Round and Square Bars.

While the disabilities of test bars with angular corners are admitted, it should be borne in mind that the standard test, as far as it existed in this country, has always been on 2 × 1-in. or 1 × 1-in. bars, and it is practically certain that whether or no the round bar is adopted, the older tests will still remain in use. The square or rectangular bars are cast horizontally, and though requiring a degree of care are easier to mould than round bars vertically cast. Differences in dimension brought about by irregularities in moulding are more easily corrected than in round bars, and figures are more easily related to those of larger or smaller bars of square or rectangular section. A sonsiderable advantage also accrues from the fact that they are cast horizontally, and may be made perfectly well in green sand.

On the other hand, the round bar for transverse test has some very pronounced advantages—a more regular structure is assured, chill is equally distributed over the surface, and its shape rules out possibilities of internal strains.

It is, however, a more difficult bar to mould, and cast in sets of four, bottom poured in a box, the bars give less regular results, *i.e.*, bars of the same set show considerable variation in strength, the percentage of wasters from dirt and blowholes is higher, and further, the specification lays down that the tensile test shall be machined from the lower end of the round bar after testing; while this last factor may generally operate all right in practice, it is not so sound in principle, as one test, one bar, should be the rule.

The carrying out of the transverse test further brings in some points in favour of the straight-sided bar. It lies easily on knife edges or radiused supports. If it is out of shape it is easily noted and can be rejected. The loaded knife edge bears over 1 in. of surface, while in the round bar it has only contact at a point in the circle, and a certain degree of indentation which may affect the result is almost inevitable. The round bar also may not be quite true, and a very small degree of ovality will naturally alter the result.

Smallest Proposed Bar Gives Low Results.

In the case of the smallest suggested round bar (0.875-in. dia.), this appears too sensitive a bar, both in moulding and testing to gain concordant results, and it has been found that the tensile test pieces of 0.25 sq. in. area, 0.564-in. dia., which are machined from this bar generally give low figures. Unfortunately the machines generally in use for transverse testing are adapted to square or rectangular bars; many of them cannot without alteration be used for round bars.

(*To be continued.*)

New Companies.

British (Non-Ferrous) Mining Corporation, Limited, 73-79, King William Street, E.C.—Capital £500,000 in £1 shares.

Lan-Bar Diecastings, Limited, 168, Stratford Road, Birmingham.—Capital £1,000 in £1 shares. Directors: C. J. Langstone and H. R. Barlow.

Pickett Metal Corporation, Limited.—Capital £1,100 in 1,000 £1 7 per cent. cumulative preference and 2,000 1s. ordinary shares. Iron, steel and general merchants, etc. Provisional directors: A. E. Fry and F. Phillips, 29, Monks Park, Wembley, Middlesex.

The Study of Foundry Sands.*

By J. E. Fletcher, M.I.Mech.E. (Consultant to British Cast Iron Research Association.)

It is comparatively easy to visualise the shape a casting will take from that of the simple uncored pattern, but immediately the pattern loses its identification with the casting by being surrounded by core prints the relationship ceases to be simple.

The difficulties of the visualisation are further increased when the pattern gives place to various sweeps, strickles and core boxes. The mould is, of course, the reverse of the casting, and very considerable experience is imperative before the mind can fully grasp in a practical manner what the shape of the mould is, and how it must be arranged so as to enable the pattern to be withdrawn, the cores placed in position, and provision made for the proper venting, gating and pouring. This may seem an unnecessary introduction to the subject, but so much has been written about the metal, with little relation to its behaviour in, and as influenced by, the mould, that the author feels that much of the failure to utilise the expected properties of a metal is the result of a lack of knowledge concerning the moulder's art and very often of the rudiments of moulding and casting practice. Indeed, the time taken for a moulder accurately to visualise the metal product of his mould is long—often as long as his working life—for the trade of a jobbing moulder has never been finally mastered even when he has tackled his last mould.

With the increasing intricacy of modern castings the moulder's art is becoming more difficult and more important than ever, that of the coremaker being included in the same category. It is a serious fact that the majority of casting failures are connected with mould- and core-making, particularly in connection with steel and iron castings, where so often many defects put down to the metal are due to incorrect gating, pouring and feeding, often in attempts successfully to produce good castings of poor design.

The introduction of machine moulding and the use of oil-bonded sands have brought about further complications, adding to the interest and responsibility of the foundry manager and foreman.

It has become far too prevalent to make light of the moulder's work, but whatever does so performs a great disservice to a most important British industry, the value of which has not yet been sufficiently recognised here. In the Far West our American competitors would fain possess more of the skilled men who, fortunately for Britain, are still being bred and trained in their fathers' craft of moulding. A thousand and one difficulties wait to trap the moulder in his task, and, as a lifelong worker in the foundry sphere, the author would again acknowledge appreciatively the foundry artisan, be he moulder or foreman, knowing full well the rough path he has to tread, especially if he be connected with the jobbing side of the industry.

Rough though that path may be, it is full of interest, and there is ample evidence, in the Proceedings of the Institute, of the fascination which the moulder's art still wields over the best of foundry workers. The mould and the material of which it is made find never-ending interest to each succeeding generation of foundrymen.

The Sand Mould.

It is with the sand mould the author wishes to speak more particularly, as this interests the majority of foundrymen most seriously. In green-sand work the hard sand grains are held adhesively in a soft meshwork of silty clay containing coal-dust particles. The actual mean moisture content of the green-sand facing mixture may be as high as 6 or 7 per cent., but, as the sand and silt grains have only thinly wetted surfaces, the moisture added is mainly absorbed by the clay. Suppose the facing mixture contains 50 per cent. floor sand, 40 per cent. new sand, with 10 per cent. coal dust, by volume, whilst the floor sand may only possess 3 per cent. of "live" clay, 70 per cent. sand grains, and 27 per cent. silty material (including unburnt coal dust and "dead" or burnt clay), and the virgin sand may contain, say, 85 per cent. sand grains (above 0.10 millimetre mean diameter), 10 per cent. clay and 5 per cent. silt, then the facing sand mixture thus made up would have the composition set out in Table I:—

TABLE I.—*Composition of a Facing Sand Mixture.*

Constituent	From new sand.	From floor sand.	Total.
	Per cent.	Per cent.	Per cent
Unburnt clay ..	4	1.5	5.5
Burnt clay and silt	2	12.0	14.0
Coal dust	10	1.5	11.5
Sand grains ..	34	35.0	69.0

The addition of 6 per cent. moisture may be considered as being absorbed by the "live" clay, or, perhaps, more correctly expressed, the water and clay form a liquid "slip," which is capable of wetting the sand and silt grain surfaces. When a clay contains from 25 to 30 per cent. of water it attains its maximum plasticity as a solid; with more water the clay becomes sticky, and there is a point where the liquid "slip" has what may be termed its maximum "stickiness." Often this occurs when the water and clay percentages are equal, or nearly so. In the above sample 6 lbs. of clay and water form 11.5 lbs. of liquid "slip" (to use the potter's term). The slip will be fluid enough to wet the surfaces of the sand, silt and coal-dust grains. The author has found that many dried facing sands have the following grain-grade composition (approximately):—

	Per cent.
Medium Sand (M.S.) grains—mean dia.	0.3mm—30.0.
Fine Sand (F.S.) ,, — ,,	0.15mm—50.0.
Silt (cs. and fs.) ,, — ,,	0.075mm—20.0

Now, if the wetted surfaces of the grains are estimated as of spherical shape it will be found that the larger of the grains (MS) have 3.5 per cent., the smaller sand grains (FS) 53.5 per cent., and the silt and coal-dust grains 43 per cent. of the total surface wetted by the clay slip. It is interesting to note from the above that 20 lbs. of silt and coal dust take nearly half the clay (about 5 lbs.).

Putting the matter another way, the 11.5 lbs. of clay slip in the above facing sand are mixed with 25.5 of silt, coal dust and burnt clay. This gritty clay surrounds the sand grains, and really controls the stickiness or adhesive power of the bond in a moulding sand and fixes the amount of moisture necessary to obtain sufficient bond strength to hold the sand grains together. The larger the silt content the greater the moisture content required.

The Character of the Clay.

This illustration is of vital importance because, seeing that the sand grains in most, if not all, British moulding sands are highly refractory because of their high silica content, the bonding clay carrying the gritty silts, will be the least refractory; yet, when it is heated by the liquid metal, must be sufficiently tenacious to hold the sand grains together.

A little consideration will show how very far from easy is the effective moisture-bonding of moulding or facing sands when these contain high percentages of silt. The more silt present the higher is the moisture-content needed and the less adhesive is the clay bond. The Americans are hard up against this difficulty, for many of their sands are smooth-grained quartz with a deficiency of clay, hence the necessity for adding further clay. They have found considerable difficulty in obtaining suitable clays for this purpose, and are often driven to use expensively-prepared bonding clays.

British moulding sands, though possessing good refractory sand grains, are variable in the character of the clay bond, being influenced by the

* A Paper read before the Glasgow and Middlesbrough Branches of the Institute of British Foundrymen.

geological formation of the deposits. This clay bond varies from almost pure silt-free kaolin in one locality to mica-bearing gritty clays in another. The absence of ferrous hydrates in the clay material always affects the stickiness of the bond. Not a few clays depend largely on the glutinous humus which has diffused from the vegetable life once existing above the sand strata.

For some years the author has placed the examination of the character of the clay bond in almost the first place in his investigations. The percentage yielded by either elutriation or sedimentation tests do not give a clue to the clay bonding characteristic needed in good practice—that is, the power of maximum stickiness with minimum clay content in a sand.

The observant foundryman has long tested this by the sense of touch by the finger and the tongue. He has "sensed" the grittiness by the way his mould surface could be sleeked without producing a broken skin or "shelling." The shovel handle is often requisitioned for indicating the fatness or leanness of a sand in clay content, and can be made to give useful pointers to the character of a sleeked surface with differing moisture-content facing sands. The test suggests a loaded sleeking-bar test for comparing surfaces produced by smooth frictional movement under varying conditions of ramming and moisture contents of facing sands. It is possible that coefficients of friction thus obtained would indicate differences in clay-bonding qualities.

It should not be forgotten that mechanical tests of this order produced under laboratory conditions, though undoubtedly useful, do not accurately imitate the practised human touch exercised by the skilled intelligent moulder, who, in ramming up an intricate mould, varies the ramming density in accordance with local venting requirements and the method of gating and pouring, whilst bearing in mind the kind of facing-sands available.

Air or Gas Voids in Facing Sands.

The possible 35 or 40 per cent. of voids between the dry grains of certain moulding sands when lightly rammed may fall to 15 or 20 per cent. in used floor sands, and the degree of pore-closing due to certain proportions of floor and virgin sands is a fluctuating quality difficult to determine by any rough-and-ready means. Good virgin moulding sands should show a void-volume of, say, 35 per cent. If the grains are coarse and uniform in size and well rounded, the individual pores are large, but if a heavily-silted floor-sand be mixed with this the permeability and porosity value may be seriously reduced. Suppose the sand-grain content of a floor sand is 80 per cent. and of the floor sand 70 per cent., the coal dust of silt grade size occupying 10 per cent. of the facing sand, the mixture consisting of floor sand 60, new sand 30, and coal dust 10 per cent. Then, if the new sand contains, when milled, 10 per cent. clay and the floor sand 5 per cent., the voids between the sand grains in new and floor sands may be:—

In floor sand	.. 60×0.20	=	12.0 per cent.
In new sand	.. 30×0.35	=	10.5 ,,
			22.5 ,,

If the whole of the silt is fine grained there will be sufficient silt *plus* clay material more than to fill the air voids thus:—

Silt in floor sand	.. 60×0.25	=	15.0 per cent.
,, new ,,	.. 30×0.10	=	3.0 ,,
Clay in floor sand	.. 60×0.05	=	3.0 ,,
,, new ,,	.. 30×0.10	=	3.0 ,,
			24.0 ,,

The porosity and permeability of such a facing sand would be defective, and, were it not for the fact that the silt of a floor sand becomes larger in grain size by clay accretion when wetted, the result would be poor.

This type of trouble is common and cannot be easily avoided except by systematic treatment and regular reconditioning of the spent sand. In British naturally-bonded moulding sands the used or spent sand has rough-grained surfaces to which "live" clay-bond adheres and outside which the clay envelope is burnt. Synthetic sands made of mixtures of sea sand and fireclay do not wear uniformly, and the spent sand is often an irregular conglomerate of polished silica grains, silt and burnt sand, little "live" clay remaining adhering to the larger sand grains. The expansion of the air and gases in the voids acts in forcing off loosely-held bonding clay, and one of the most useful characteristics of many British moulding sands is the bond-holding power of the ferrous hydrate portion of the grain envelope when partially burnt (dehydrated). In green sands the air voids occur in the silt *plus* clay portion, the action of the heat expanding the air and gases, compressing the soft clay and aiding adhesion.

The author has elaborated at some length the apparently microscopic character of the facing sand structure, showing that this is a replica of the structure of a cement concrete, save that the cement practically fills the interstices between the broken angular stone fragments, whereas in the moulding sand the interstices between the sand grains are only partially filled with the silty-clay bonding material, leaving pore spaces and paths throughout the mass.

How Hard Ramming Acts.

A better illustration would be that of a sponge whose cells are filled with pebbles, the porous material of the sponge being analogous to the porous silty-clay meshwork of the facing sand mass. In the green-sand mould the meshwork is moist and has comparatively little mechanical strength at the moment of pouring in the metal.

This surface strength of the green sand depends on the amount of ramming and on the moisture contents, for, as already shown, the sand grains may be held together by a very fluid clay "slip"—when the moisture content is too high—or by a thicker and more adhesive clay "slip" when the moisture content is sufficiently low. Excessive ramming lowers the porosity and permeability, but generally increases the tensile strength of the bond—dependent, of course, on the moisture contents and on the strength characteristics of the clay, as influenced by the amount of gritty material enclosed.

Skin drying the mould surface thickens the constituency of the clay "slip" by driving off excess moisture and strengthens the bond. Hence when a sand mould is dried at a temperature in excess of the vaporisation point the water in the clay "slip" is evaporated and, as the vapour escapes along the pores in the clay and through the larger voids between the sand grains, the surface of the clay "slip" next to the sand grains is the first to dry and adhere. Good clays shrink slightly when drying, without cracking, whereas poor clays have a high shrinkage rate and crack in drying. Again, in some sands the larger grains are brittle and friable, fracturing during milling and forming silt or smaller sand grains. Such grains "spall" when the hot metal touches them, the clay bond being broken. These may seem small points, and obvious, but whenever a sand grain has a weak structure, due to certain mineral inclusions, such as calcite and magnesite (carbonates), it is liable to burst under high temperature conditions.

It will be seen, therefore, that the examination of moulding sands involves much more than can be shown by the usual practical methods, useful as these are and complementary to research methods. Nature has laid down our moulding sand deposits in water, as a rule, though many of them have been sun-dried and wind-drifted later and the grains rounded. The clays, which were the last portion to become sedimented, drifted down under the glacial sheets until they found a resting place, and, in a warmer age, were washed and carried by streams over the beds of sand lower down the mountain slopes. Ages passed during the period of clay-water saturation of the sands, which, under pressure, became sandstone or, in looser formation, became sand-beds of varying clay content. In many cases the upper beds have been washed clear of clay, whilst the lower have become more strongly clay-saturated.

The ganister clays and silts covering the grit-stone rocks underlying the coal measures in many parts of Britain were, after the erosion of the rocks, carried over the sand-plains at the foot of the great Pennine Range and gave birth to the best of the Bunter moulding sands. In other

places the clays were less refractory, and, as a rule, these are found further away from the mountain chain and covering the plains of the South and East of England. In their longer travel path the sand-bearing streams left the coarser silt and sand grains behind them, and hence are less silicious and richer in kaolinitic and alkaline minerals. In Scotland the trough of the ancient Lake of Caledonia of Archibald Geikie, in the lower dip of which the Coal Measures of the Forth and Clyde Valleys have been deposited, furnished the sands and rotten rocks of the Old Red in the Blairgowrie and Wormit districts and of the Carboniferous in the Glasgow-Glenboig areas. In the Scottish foundrymen's future search for moulding sands and refractories the N.E. to S.W. Caledonian Lake belt will doubtless be further explored, but, maybe, the lack of "lazy" plains where the sands and clays would rest in peace will make the search comparatively barren, for it would appear that the great ice sheets carried the valuable grains over the Border—for even in Derbyshire, boulders and grains from as far north as Galloway are found. The South-flowing glaciers swept the mountain tops of Lower Caledonia and carried their silicious gems to England.

Analogy Between Cement Concrete and Greensand Structures.

Returning to the analogy between concrete and moulding-sand structures, practical experience has shown that in the ramming of a block of concrete the percentage of water used in the mixture is of great importance. If a large excess of water is used in the making of Portland cement concrete the broken block will reveal a honeycomb appearance where the surplus water has been left, and, instead of getting a close texture of high density a very poor and weak concrete results. When ramming up successive layers of concrete the top of one layer may, after resting overnight, be overwetted before ramming on the next one. The material at the joint may then be weakened by the excess water content, though the sleeking may hide the defect. Years afterwards, when breaking up the wall, fracture often takes place along the lines of the poorly-made joint. This has a parallel in badly-rammed moulds where one level is rammed up with comparatively dry sand and the next with over-moistened sand; the over-wetting of the first rammed layer so as to knit with the next leaves weak-dividing surfaces which may lead to distortion of the mould surface and to "steam blows" when the metal comes into contact with the mould face. The mending of damaged moulds through bad pattern draws frequently leads to similar trouble, causing "scabs" and porous surfaces, especially where the sand is in the top part of a mould and held up by gaggers.

The strength of the clay meshwork enclosing the sand grains is a matter of importance, just as is that of cement in the bond of a sand mortar of the 3 of sand to 1 of cement type. Here, if, say, 15 per cent. of finely ground sand is mixed with the cement and tested "neat," the tensile strength of the silty cement so formed may be the same as that of the pure cement. But, if this silty cement be mixed with the coarse sand to form a cement mortar the strength of the mortar will be seriously reduced by the fine silt additions.

This has its analogy in silty-clay meshwork forming the bond of a moulding sand. The bad effect of a fine silt in the cement mortar of Rag-stone concrete has often been noted, in lowering the strength points the moral in the realm of moulding sands, where, in facing sand-mixtures containing coarse and fine silts the adhesive properties of the clay may be reduced by silt dilution.

The Examination of Moulding Sands.

The author has evolved a method for examining moulding sands based on Nature's process of depositing them, by sedimenting samples in water after agitation. The simple sedimentation of a definite weight or volume of sand in a test-tube containing a fixed volume of water is used. The clay and sand separate the sand sedimenting first in the order of grain size, followed by the silt and, finally, by the clay. Curves showing the progressive subsidence of the sand and coarse silt and of the concentration of the clay, in relation to the time occupied by the subsidence, give a graphic characterisation of the sand, silt and clay enabling the experimenter to identify and classify the sands from various areas and to obtain similarly valuable indications of the condition of facing, floor and core sands.

In developing the method, the author has found the chemical and mineralogical analyses of the clay portion, which can be poured off the sand grades after these have sedimented firmly in the lower part of the test tube, of great value. The analysis of the washed sand grains gives an index to the kind of rocks giving birth to them, and plainly indicates the degree of refractoriness. Similarly the clay analysis shows the relative proportions of silt and pure clay (when expressed in terms of the mineralogical constituents), and is an index to the adhesive and refractory properties.

The method for carrying out this test has been illustrated and described on pages 391 and 392 of the November 4, 1926, issue of THE FOUNDRY TRADE JOURNAL.

Sedimentation Tests.

The two subsidence curves, as plotted according to the above method, enable the percentages of the grain sizes to be determined with precision in any range, the upper curve giving an index to the silt content in the clay and to the degree of fineness in the clay texture. By repeated sedimentation of the same sample a series of curves is obtained. From these, the condition of a floor sand can be found, the gradual washing off of the temporary clay bond from the sand and coarse silt grains continuing until there is no further change in the curve. By the use of a hydrometer, placed in the agitated water, readings taken at, say, five-minute intervals, can be plotted on a time base and show the density of the liquid. This curve is of the same character as the upper subsidence curve and indicates that the curve is one of clay-plus-silt concentration. The effects of milling can be correctly and readily diagnosed by means of a series of subsidence curves, plotted from samples milled for different periods. The colouration of the water of subsidence gives a clue to the permanence or otherwise of the ferric-hydrate bond which plays so vital a part in the wearing life of a moulding sand. The testing of a large number of moulding sands from the various British and Continental moulding-sand areas has proved the utility of the method and furnished data from which the characteristics of any sand may be diagnosed. The method, when used along with sieve tests, elutriation determinations of the grain-grade percentages, compression and transverse tests, is a valuable help to the sand investigator, and also is a simple aid to the foundryman who, after a little experience, will have the means for determining the chief practically useful characteristics of a moulding, facing, or floor sand.

The author's test has been used by Mr. E. W. Smith, of Chicago, who, after shaking up the tube with its sand and water contents by hand, places it on a vibrator for half an hour before putting it to rest for twelve hours. The depth of the clay slip portion resting on the sand is taken as being bonding material, and is expressed as a percentage of the total sand and clay slip depth. Mr. Smith would say that if the depth of the sand portion is 3 in. and that of the clay slip 1 in., the bond percentage is 25 per cent. and the silica 75 per cent. For many years the author has recorded these proportions as given by the subsidence of many sands, but long ago found that the clay slip might contain between 30 and 60 per cent. of water, whilst the sand column might hold from 25 to 40 per cent. of water, according to the pack of the grains. Further, some clay slips continue to stiffen for days, the depth of the slip band diminishing with time, whilst that of the sand column remains stationary. When applied to floor sands, the so-called clay-slip band may contain as much as 50 per cent. of very fine silt and burnt clay. It cannot then be considered as bond. The author pours off the slip, evaporates the water content, and weighs the solid material left. Similarly with the sand, the dried weight of which is compared with that of the dried sand originally charged into the tube. By this means the sand-grain percentage can be measured. The dried slip must then be analysed and the result may be readily interpreted in terms of the mineralogical constituents. By this means the two portions of

the sedimented column can be expressed in percentages of sand, silt and clay, the latter being expressed as kaolinite and limonite. It is then possible to say whether the clay contains fine silt or not. The ignition loss indicates the loss of water of crystallisation by the kaolin and limonite, the loss of CO_2 by the carbonates of lime and magnesia, and, in facing and floor sands, the loss of carbon through the ignition of the coal dust.

Rough-and-ready methods of sand examination are misleading unless the mean extent of error in such methods can be obtained by paralleling the rough tests with exact ones repeatedly, so as to arrive at results which closely approximate to the actual facts. The values for gas permeability of sands, taken under conditions which do not pproximate to actual conditions, are unreliable, for the effect of the molten-metal contact sets up a number of actions which do not obtain in cold columns of dried air through which cold or hot gas or air is forced in a given time and measured.

Foundrymen are still without a satisfactory test for permeability under casting conditions The same may be said of compression and transverse or tensile tests of green or dry sand. The strength of a sand may be increased or decreased immediately the hot metal touches it, for, as has been shown, the clay slip which forms the bond in a green sand becomes more adhesive when a portion of its water is driven off; whereas if the heat not only evaporates the moisture, but dehydrates the clay, the bonding strength may be seriously weakened according to the type of clay in the bond. A facing wash of silica graphite, or other coating may sufficiently protect the sand surface from the dehydration of the clay bond and lengthen the life of the sand, in addition to strengthening the bond by increasing its adhesive power. A transverse bar tested with one face in liquid metal would more nearly approach actual conditions, but even this test would suffer from differences in ramming conditions.

These practical aspects of the sand-testing problem do not in any way discount the research value of the investigations made in this country and elsewhere on virgin sands. Without them there would have been but little progress in our knowledge of the properties of moulding sands. The advance in this sphere of research has been very marked during the past decade. Future work must lie in more practical application of the laws governing the adhesive strength of the bonding clays and other substances, the skin expansion of facing and core sands, the heat-conducting rates, and the relationship of these to the cooling rates of the metal in contact with the sand during solidification and the stages of cooling wherein the structural changes in the metal take place.

The author in 1918 ("Journal of Iron and Steel Institute," vol. 2, pages 243 and 244) showed that the sand in contact with the cooling metal in a mould indicated differences in the rate of heating which corresponded with that of the recalescence range in the iron or steel in contact with the surface of the sand mould. Later experiments have emphasised this fact, and have shown that by superheating the sand mould before pouring in the metal, the violence of the skin stresses of the casting (and probably the internal stresses also) can be reduced. When the mould is preheated to between 400 and 500 deg. C. the cast iron poured into it cools slowly through the recalescence range (750 to 690 deg. C.), producing the pearlitic structure, releasing gases, and smoothing out the violence of the structural change, and with this the relieving of the skin and internal stresses.

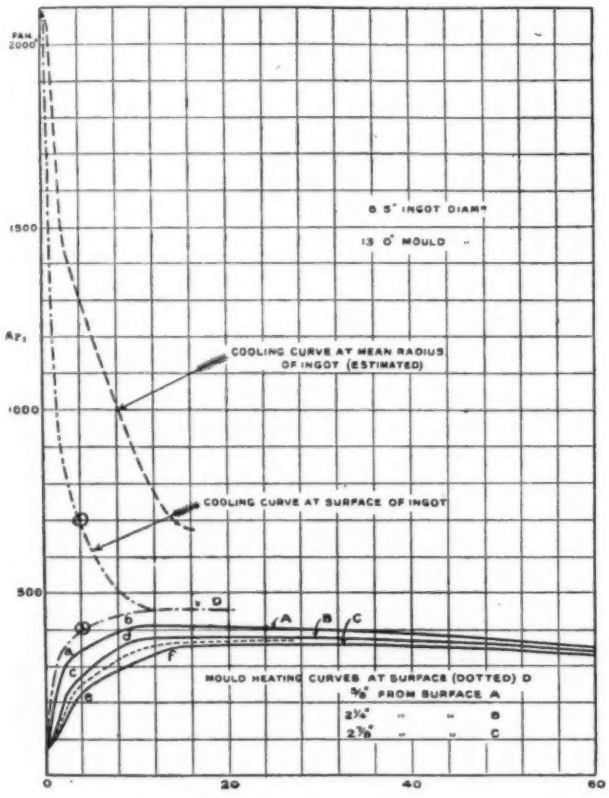

Fig. 1.—Cooling of Cast-iron Ingot.

Long before anything was known of the recalescence phenomena of carburised iron, steel founders looked upon the annealing of steel castings at a temperature of about 850 deg. C. as being a means of relieving the stresses set up in cooling. In the Perlit process the same phenomenon occurs, and it is significant that the temperature of 400 deg. C. found by the author to be coincident with 700 deg. C. (the recalescence point) at the casting surface and recorded in 1918 (see Fig. 1), is approximately the mould heating temperature for a thick casting as used by Lanz. It will thus be seen that by preheating a sand mould to this readily-ascertained temperature, corresponding to that reached by a cold mould when the contained metal cools to about 700 deg. C., the pearlitic structure of cast iron is promoted and the skin and internal stresses minimised to a very considerable degree.

In calling attention to this modern foundry development the need for further knowledge in the domain of mould making and treatment is emphasised, especially in the section dealing with the influence of the mould material on the structure and quality of the casting formed within its walls.

Institute of British Foundrymen.

LUNCHEON AND PRESENTATION OF SOUVENIR MEDALS TO PAST-PRESIDENTS.

At the Engineers' Club, London, on Thursday, February 17, THE FOUNDRY TRADE JOURNAL gave a luncheon to the Past-Presidents of the Institute of British Foundrymen, when medals were presented to them. Capt. R. B. Crewdson was in the chair, and the presentation was made by Sir William Larke, Director of the National Federation of Iron and Steel Manufacturers.

THE CHAIRMAN announced the receipt of messages of regret for inability to attend from Col. Cheeswright, Mr. Riddell, Mr. J. Little, Mr. H. L. Reason, Mr. J. Cameron, Mr. R. O. Patterson, Mr. W. Lambert, and Mr. J. G. Pearce.

MR. V. C. FAULKNER (President of the Institute of British Foundrymen) said the object of the meeting was the quite simple one of asking Sir William Larke to present medals, which represented a token of esteem, to some of the Past-Presidents of the Institute of British Foundrymen. Of the seven persons who originated the Institute two were present that day. It had been the custom to present a President, on his leaving the chair, with an illuminated address. Modern schemes of decoration, however, together with artistic wives, usually resulted in such illuminated addresses being relegated to the attics, and, therefore, acting on a hint given by Mr. Patterson, it had been decided to present medals to all the Past-Presidents of the Institute, so that they could wear them at any social gathering of the Institute. Not only were the medals to be presented to the living Past-Presidents, but they were also to be presented to the widows or representatives of those Past-Presidents who had passed away. It was particularly pleasing that this function should take place during his year of office as President, and he was exceptionally proud that they had been able to induce Sir William Larke, who took such a live interest in the Institute, to perform the task. Moreover, Sir William had hinted to him that in future, when he came among the members of the Institute, it would not be as a guest, but as a member. (Applause.)

The Passing of Individualism.

SIR WILLIAM LARKE, who was given a cordial welcome, first expressed his very great appreciation of the invitation to participate in this gathering. In the first place, he felt that the work the Institute was doing was setting an example to other industries which, if it could be done as thoroughly in other branches of industry as it was being done by the Institute of British Foundrymen, it would make a considerable difference to this country in inducing an industrial revival. The Institute of British Foundrymen was opening the windows of technical knowledge and applying it in practice, and, moreover, was freely exchanging between themselves information gathered from their individual practice and making it available to all. In his own humble way he was striving to do that throughout the whole of the iron and steel industry. The absurd idea had grown up that, because we had in the past created an unquestionably great industrial position by individualism, that same process ought to satisfy us for the future. Individualism was naturally our great national characteristic, but we too frequently overlooked the fact that when the war came it destroyed all the relationships that existed up to 1914, whether they were commercial, or technical, or whatever they might have been.

Co-operation Essential.

In re-building these things, therefore, individual effort alone could not do it in any reasonable period of time. It must be done by collective effort whereby all those individuals who were engaged in particular industries co-operated together for the benefit of the industry as a whole, and of the country as a whole, and it was exactly that function which the Institute of British Foundrymen was performing so well for the industry it represented. He had been particularly gratified to notice the interchange, internationally, by the Institute of information and Papers, because that was of the utmost importance. If our industrialists could only realise that by the wider and more general circulation of knowledge we could effect a greater improvement in our work and a greater reduction in our costs—in other words, a greater increase in productive efficiency, resulting in a greater amount of business being available to all of us—the better it would be for the benefit of industry and the country, and for the individual.

The Steel Age.

The present was an iron and steel age, and in his judgment, if we had witnessed in 1914 the death of an old era, we were to-day privileged to be living at a time of the birth of an entirely new era. He did not believe that iron and steel as a structural material had come into anything like its own. Take railways, for example. We were inclined to look at the absorption of iron and steel by our railways as having reached the saturation point, but that was not true. The railway companies, for example, were still using wood sleepers, which were getting yearly more difficult to obtain. He admitted that wood sleepers had many advantages, but it was up to the iron and steel trade to produce the steel sleeper that would satisfy the position. If that could be done, the consumption of iron and steel on the railways would be doubled at one stroke. The replacement of wood by steel sleepers would mean additional consumption of something like 300,000 or 400,000 tons of steel annually. Then there were many other structural materials which steel could very well replace.

Present Position.

Coming to the present position, Sir William Larke said the iron and steel trade was making a remarkable recovery after the strike, no doubt due to the fact that advantage was taken of the strike period to bring maintenance work up-to-date and enable the works to be ready to start to deal with the accumulated orders. During January 450,000 tons of pig-iron were produced. This perhaps was not very much compared to capacity of twice this amount, but was due to the fact that some furnaces were in the process of blowing and were not giving full output, but the quantity in question was 80 per cent. of the January production in 1926. With regard to steel, the production in January was 730,000 tons, one of the highest outputs which had been made in January for a year or two. It was at the rate of 8,750,000 tons per annum, which represented 73 per cent. of our effective capacity. This, he thought, reflected great credit both on the management and the men. There were many people who said that we are living up to a higher standard than we can afford, and that was probably true. The difficulty, however, of reducing our standard of living was as great as it was undesirable.

Avenue of Progress.

The only method by which we can maintain our standard of living and perhaps even improve it, was to increase the volume of production per unit of labour employed, in other words, reduce our costs in manufacturing industry. It could be done and he would say quite frankly, with some knowledge of industrial conditions and people in other countries—where he had had opportunities of observing them—that there is no country in the world from which he would rather have to fight for business in the export markets of the world than this country. We possessed the greatest number of highly-skilled workers of any industrial manufacturing country of the world, we were geographically best situated for the distribution of our products and we had the best distribution of raw materials in the form of ore and coal contiguous to one another, of any other producing country in the world, and still we were not yet using our advantages to the full extent for lack of co-operation. Our difficulties were

mainly psychological. He was not unmindful of the subsidy to competition which Continental countries had had in the form of collapsed exchanges, but that was passing and we were now entering an era when competition was based more on efficiency of production. The standard of living in this country as compared with the Continent was for the moment a handicap, but leaders in industry had to try to solve that difficulty by some compromise, trying to avoid a reduction of the standard of living by giving every encouragement to the men to co-operate in improving our efficiency of production. He did not know the foundry trade so well as he knew the iron and steel trade, since he had left engineering some time ago, but in the iron and steel trade substantial strides had been made in improving the efficiency of production of iron and steel.

"No" and "Yes" Mentalities.

The costs in which the foundry industry was interested were the technical costs. The final costs were something which economic forces made us take care of, but at the same time if we could not achieve technical costs which were comparable with those of our competitors, we should be in a bad case indeed. Personally, he had immense hope, indeed, more than that, he had an abiding confidence in our ability ultimately to hold our own. To do that, however, we must adopt a broadminded attitude towards all our problems and difficulties. We must be ready to interchange information and we must do what Sir Alfred Mond so admirably said recently, we must not be people with the "No" complex and say "No" to every new thing because it is a new thing. This merely indicated a lazy habit of mind and lack of energy and enterprise. On the contrary, we must be people with a "Yes" complex and say that if a thing is new then we ought to try to understand it and form a proper judgment as to whether it should be adopted or not.

Continental Situation.

Continuing, Sir William Larke made some comments with regard to the Continental situation and said that he omitted the American situation for the reason that it was very much an internal one at the present time. The American cost level on thewhole , over-all, was rather higher than ours. Therefore at the moment, although they produced half the total production of iron and steel of the world—last year they produced 49 million tons, and as the total production was nearly 96 million tons the Americans produced rather more than half—the American situation is not the immediate problem with which we are faced in this country. Whether we liked it or not in this country we were faced with competition from Continental producers in all markets of the world. The position at the moment with stabilised exchanges was that Continental costs were rising. He knew that some people might ask him, when they heard that, why it was that if costs were rising on the Continent there had been falling prices from the Continent during the past week or two. He believed, however, said Sir William Larke, that this fall in prices had involved a great loss. The Continental makers had been selling below their actual works cost. This, at any rate, was the information he had been able to obtain from fairly authentic sources.

Steel Apportionment Agreements.

Having explained in some detail his reasons for coming to this conclusion and suggesting that probably before long the Germans would be requiring some modification of the Continental steel agreement to carry it beyond mere regulation of output, Sir William Larke said there was no secret with regard to the position concerning the attitude of the British iron and steel industry. It saw in the Continental agreement a possibility of the stabilisation of business conditions. Possibly the agreement had not succeeded in stabilising them very effectively yet, and it might be that that would be the factor which would induce Germany to desire the agreement to go further. Anything that tended to stabilise the price position was a condition that we in this country had needed ever since the Armistice. There was no actual lack of potential demand. The position was that we were not giving our purchasers any chance to make their demand effective. Purchasers had been faced for the last 5 or 6 years with a continually falling price level and nobody would buy or enter into forward commitments on a falling price level. No foundryman, for instance, would enter into long-term forward contracts for raw materials when he saw the price level was continually falling, and they could not expect their customers to do it either. We had, in fact, largely through no fault of our own in this country, although he thought we might have done a great deal better than we had, practically prevented customers from ordering owing to the continually falling price level, and general uncertainty of the market. That was a position we had been forced into largely by competition from the Continent. The competition from the Continent had had no real relation to costs, and the reasons for it were largely political and partly due to new countries undertaking the control of the iron and steel industry, etc. However, under the present conditions of stabilised exchanges, we in this country must concentrate upon reducing our costs so that we could afford to maintain the present monetary wages. If we could only get everyone to realise that high wages and low costs go together, then he had no fears for British industry.

Having given this brief review of the general position, Sir William Larke referred to the recipients of the medals which he was about to present.

Mr. F. J. Cook, Birmingham (President, 1908 and 1909).

Mr. Cook was one of the seven original founders of the Institute, and he was the third President. He has carried out a considerable amount of research on matters connected with the metallurgy of cast iron and upon foundry practice, and has read numerous Papers before this Institute and before other engineering Associations. In 1922 he gave a Paper to the American Foundrymen's Association, which was officially presented on behalf of this Institute, and was the first of the International Exchange Papers which have now become a marked feature of most of the Conferences of this and other foundry technical Associations. He was also the first recipient of the Oliver Stubbs Gold Medal, which was awarded him in 1922. Mr. Cook still takes a very active part in the affairs of the Institute, of which he is one of the Trustees. He is also a Vice-Chairman of the British Cast Iron Research Association.

Dr. Percy Longmuir, Sheffield (President, 1910 and 1911).

Dr. Longmuir had considerable foundry experience in his early days, and then proceeded to Sheffield University, where he had a brilliant career, and of which University he now holds the degree of Doctor of Metallurgy. Dr. Longmuir has read numerous Papers before the Institute, and his work has largely been directed towards introducing a more scientific spirit into the foundry industry, and of interpreting scientific discoveries in such a way that they are of value to the practical man. He was a Carnegie Scholar, and as such has been responsible for a number of valuable researches.

Mr. S. A. Gimson, Leicester (President, 1913 and 1914).

In the early days of the Institute Mr. Gimson rendered very valuable service on the administrative side of the organisation, and the Institute was largely built up as a result of his advice and his guidance. He is the head of the well-known engineering firm in Leicester, and has taken a very important part in the civic and public life of that city.

Mr. J. Ellis, London (President, 1916 and 1917).

Mr. Ellis was one of the first members of the Institute, and he has done a good deal of valuable work in the direction of making known the value of the Institute to members of the trade to whom it would be of use, and so increasing its membership. By his example and his devoted and painstaking work he has contributed in no small measure towards increasing the prestige and also increasing the membership of the Institute.

Mr. Oliver Stubbs, Manchester (President, 1921 and 1923).

Mr. Stubbs is largely responsible for the International relations that exist between the various foundry technical institutes. Early in 1922 he paid a visit to the United States, and there laid the foundation of the international relations. He followed this by inviting representatives of various foreign Associations to a luncheon at Birmingham in June the same year, and it is as a result of his work in this direction that the present feeling of close fellowship exists between the various foundry associations. Mr. Stubbs is President of the National Iron Founding Employers' Association, and some years ago this Association presented a sum of money to the Institute of British Foundrymen, from the interest of which is purchased each year the Oliver Stubbs Medal. The Medal is awarded to the member who has performed conspicuous service to the Institute during the year. Mr. Stubbs has brought to bear upon his work in this Institute a considerable energy and foresight which has been of inestimable value in building up and consolidating the Institute's organisation. He is Vice-Chairman of the British Cast Iron Research Association.

Co-operative Measures.

SIR WILLIAM LARKE congratulated the Cast Iron Research Association upon having Mr. Stubbs upon its Executive, and added that although his own Federation was not comparable in its functions to the Institute of British Foundrymen, or even the Cast Iron Research Association, it did all that was possible to co-operate with associated industries. The Federation had just appointed Mr. Pearce, the Director of the Cast Iron Research Association, to be a member of the Federation's Fuel Economy Committee, which was studying the fuel economy problem in the iron and steel industry, and was also arranging that Mr. Pearce should be associated with all the Federation's fuel economy developments. After all, the members of the Federation provided the raw material which the members of the Institute of British Foundrymen were handling, and the relations between them, so far as their technical position was concerned, could not be too close. Therefore, he felt confident that by the cordiality with which he personally had always been received by the Institute of British Foundrymen, there would be mutual co-operation of the closest character in the future.

Aims and Objects.

MR. OLIVER STUBBS, in proposing a vote of thanks to Sir William Larke, recalled how, up till 1918, Sir William was with the British Thomson-Houston Company, Limited, and during the war was Director of Controlled Establishments. He believed he was right in saying that during that period Sir William devised and introduced the priority scheme. During the time the scheme was in existence, there had been many occasions upon which they had not always agreed with Sir William.

SIR WILLIAM LARKE: You do not know what I saved you. (Laughter.)

After the war the services of Sir William as Chairman for the Disposal of War Stocks were much appreciated, and finally became Director of the National Federation of Iron and Steel Manufacturers, the statistics issued by which organisation were the least-disputed figures of any that we have. They had all listened with very great interest to the speech Sir William had made, and particularly to the point he had made as to the necessity for an increase in the output per man.

So far as the work of the Institute was concerned, he believed it was doing more to keep peace and good feeling in the industry than any other association connected with engineering. The Institute tried to make it possible for all those engaged in the industry to come together and discuss technical problems and scientific methods. In this country there was not always that personal touch between the management and workmen, and he felt that the work of the Institute was helping very considerably towards that end.

On behalf of the recipients of the medals, he thanked Sir William Larke for being present and for the interesting remarks he had made.

SIR WILLIAM LARKE, acknowledging the vote of thanks, said there had been no need to thank him because he regarded it as an honour to have been invited. Regarding Mr. Stubbs' remarks, he wondered whether they had ever thought of applying the principle of the overhead bonus on the output of the whole shop, in addition to any other system that might be in vogue. Another point concerning workshop relations had been brought up in a discussion at which he was present on the previous day. The point raised was that foremen and charge hands should be selected more for their ability to handle men than for their knowledge of the work. Possibly too much stress had been laid in the past on selecting men as foremen and charge hands because of their technical ability, without sufficient regard to the fact that the most important material these foremen were handling was not the raw material they were working up, but the men who were doing the work, and it was leadership that was required.

MR. F. J. COOK, proposing a vote of thanks to Capt. Crewdson for presiding, said it was a real pleasure to rub shoulders with some of those who bore the heat and burden of the day. Probably he had been asked to propose this toast because he was the oldest living past-President of the Association. As such, he could appreciate more than many others the great benefits the Institute had received from working with the Chairman and those with whom he was associated.

THE CHAIRMAN, responding to the toast, thanked those present, on behalf of the staff of THE FOUNDRY TRADE JOURNAL, for the cordial vote of thanks that had been passed. Those of the staff were exceedingly proud of the fact that they were allowed to play their little part in the affairs of the Institute. There was no contract; he believed there had been none during the whole of the existence of the Institute, and he hoped there never would be. The work that was being done was based solely on goodwill, and as long as they were able to render any service they were quite satisfied. They did their best and hoped to remain, in a real unofficial way, the representative organ of the Institute.

Foundry Statistics.

During 1926 the United States of America exported 25,208 tons (2,240 lbs.) of pig-iron, as against 32,674 tons in 1925. Their exports of cast-iron pipe were increased from 19,936 tons in 1925 to 34,130 tons in 1926. Iron castings, however, decreased from 10,412 tons to 8,837 tons. In steel castings a gain was shown, the amount exported being 7,564 tons, as against 4,209 tons in 1925.

Imports of pig-iron grew from 441,425 tons to 445,602 in 1926, whilst during the year 83,873 tons of cast-iron pipe were imported. Previously this item has not had a separate identity, but was included with tubular products.

During December the Belgium-Luxemburg Customs Union imported from Great Britain 1,039 metric tons of pig-iron and exported 14,971 tons; their total import and export figures for this commodity being 27,416 and 17,575 tons. So far as castings were concerned, they bought 8 tons from Great Britain and sold to us 1,408 tons. From all countries these figures read—imports 526 tons and exports 7,265 metric tons.

Silica Bricks for Steelworks.—At a recent meeting of the West of Scotland Iron and Steel Institute, held at Glasgow, MR. A. H. MIDDLETON and MR. C. BRIDE read a Paper on "Silica Bricks for Steelworks." The lecture described the methods of manufacture of silica refractories, and showed how their different characteristics were produced. The conclusion was that the most resistant structure seemed to be that developed by producing a medium-grained texture in the grinding process, and by giving the material sufficient firing in the kilns to produce the strongest possible tridymite growth in the matrix. By those means the porosity was reduced, and a hard structure was produced which would resist the abrasive action of the furnace gases.

XUM

Institute of British Foundrymen.

London Junior Section.

On Saturday, February 19, members of the London Junior Section spent an interesting afternoon at the Ealing Park Foundry, Junction Road, South Ealing. This foundry is thoroughly up-to-date and under scientific control, and the visitors, who were shown round by Mr. R. J. Shaw (director) and several of his staff, saw many interesting devices of modern foundrywork.

Tea was afterwards kindly provided in the offices of the Ealing Park Foundry, at the conclusion of which a very hearty vote of thanks, proposed by Mr. H. R. Slater, and seconded by Mr. W. J. Johnson, was passed to Mr. Shaw and his firm for their kind hospitality.

An address was then given by Mr. A. R. Bartlett, his subject being "The Repeat Job and Some Ways of Handling It." Mr. J. P. Ellis (Vice-Chairman) presided.

The Repeat Job in the Foundry and Some Ways of Handling It.

The founder must endeavour to understand what the designer wants, and why the patternmaker desires to do certain things. A little consultation with him will result in the correct camber being given to a pattern which requires camber. Also, they must realise that the foundryman has difficulties to contend with, and he knows what they are, and the best means of combating and overcoming them. He may be able to suggest some alteration in design to enable him to place his runner, so that the metal does not strike against cores or projecting parts of the mould when entering; also point out the unequal thickness of metal, so that the draughtsman may see his way to meet him and thus save trouble and disappointment.

Having decided these points, the foundryman has to discover what tools are to hand that will help him to make a cheap job, and get the greatest quantity out in the shortest time. It may be that he has not the best machine for the class of work in hand, and has not the opportunity of getting what he desires. This is a time when his initiative must come into play, and he must adapt himself and his job to the tools that he has. He may have to make joints in the casting which would not be necessary under favourable conditions, or it may be necessary to have cores to get overhanging parts moulded on the machine.

It does not follow that the moulding machine is the best and cheapest means of handling all repetition work. Snap-flash boxes, with pattern plates, have proved most expeditious in a large number of cases of shallow and simple work. A great advantage which snap-flasks have over permanent boxes is the saving of floor space for storage, and the time saved in the subsequent knocking out and stacking with permanent boxes. One very great argument against snap-flasks is that one cannot get as many castings per box, on account of the possibility of bursting out if the box contains as many castings as can be put into permanent boxes of the same size. Again, more labour is needed to weight down the snap-flasks, and sand must be banked round the moulds to try to prevent the possible run out, whereas with permanent boxes clamps would do the fastening and the boxes hold the metal in.

No matter whether one is using a machine or not, it is undoubtedly true that there are advantages in using pattern plates for repetition work over using loose patterns. With the pattern plate the joint is already made and an accurate parting is assured every time. With loose patterns the joint has to be made, and in the case of circular work or with a pattern made whole, the joint is often made in an indifferent manner, and the lift is then bad if the joint is too low; or in the case of the joint being too high, the draw is bad, thus necessitating tooling and mending of the mould, and producing indifferent castings.

Follow Boards

With loose patterns one may very possibly make an odd size or, as it is often called, a "follow board," but again the pattern plate has its advantage over this. With the pattern plate there are not the patterns to handle, as in the case of many small patterns to be arranged on the odd-side. Also, when it becomes necessary to draw the patterns there may be a dozen or two to draw; whereas with the pattern plate all the patterns are drawn at once. In addition to this it can be well realised how efficient the draw must be with the pattern plate as it is drilled to the same jig as the moulding boxes, and, therefore, the box pins act as a guide when lifting the pattern plate. The odd-side being, as a rule, made of plaster of Paris or wood, it gets worn out, and needs replacing, whereas with proper care the pattern plate will last for an indefinite period. Of course, a proper system and keen supervision are always necessary to ensure good results continuously.

Careful attention must be given to the efficient mixing, grinding and sifting of sand. This must be done by mechanical means where a large output is desired. It is obvious that in the greater number of cases where small engine work is made from pattern plates, that the output would be much larger if made on a moulding machine than if hand moulded; not only because the machine can produce faster, but chiefly because the drawing of the patterns, no matter what method is employed, will be more accurate. All moulders appreciate good patterns. The initial expense in making a good pattern plate is rather high, but to be a really paying proposition it must be a good one; therefore, it is essential that a sufficient quantity will be got off the job or that there be prospects of repeat orders before deciding to make the plate. It used to be thought that only small work could be successfully made from pattern plates or on the moulding machine, but with the improvements in machines and methods of to-day there is no limit to the size of pattern plates.

Few moulders are able to make a perfect pattern plate, and it is usual to keep the same man on the job. Even with good men making pattern plates a more accurate pattern is the one that lends itself to being machined or finished as a master pattern, and then fixed to a perfectly machined surface plate. It is imperative that the pattern be fixed, so that there is no movement when vibration takes place, and especially is this the case if the pattern plate is to be used on a moulding machine. If the pattern plate is to be used by the hand moulder, then it is advisable to have the plate 1 in. or 1½ in. larger all round than the moulding box, to facilitate rapping without the risk of the box being struck, and the possible loosening of the mould caused thereby. The moulder should be provided with a mallet, as a hammer or piece of iron will break pieces off the plate, and very probably crack or break it, and ruin the plate.

Another reason for advocating master patterns to be fixed to a pattern plate in preference to being cast on, is that the cast plate often warps in the cooling, as the thickest part is always where the patterns are, which is obviously the centre, and the last place to cool. All foundrymen will appreciate this, and know how difficult it is to avoid it, no matter how the casting is eased during cooling.

Another point to be considered, especially where large plate work is concerned, is the necessary camber required to get the ultimate casting perfect. Runners and risers often tie the casting, and cause trouble in this way.

The point cannot be too strongly impressed as regards perfect pins and pin-holes. It is advisable to always use a standard size of pin for each size of box. These should be made of steel, and all the holes, both in the pattern plates and boxes, should be made to receive a hardened bush, accurately drilled, with an allowance of 0.006 on holes up to ¾ in., and increased slightly on larger ones.

It is infinitely better to use only two pins on all plate work of a small type, as if more are used they are likely to get out of order much more quickly. If one pin is used in the top box and one in the bottom box, the box cannot be put on the wrong way round. With large work, however, three or four pins are advisable.

The lecturer showed a number of lantern slides, and his lecture aroused an interesting discussion.

A vote of thanks followed, being proposed by Mr. V. C. Warren, and seconded by Mr. B. B. Kent.

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Trade Talk.

Vickers, Limited, announce that they have received an order from the Admiralty for a fleet repair ship.

Norman Pearson & Company, Limited, 83, Pall Mall, S.W.1, have removed to Lots Road, Chelsea, London, S.W.10.

The Tees-side Bridge and Engineering Company, Limited, have obtained the contract for 16 large oil tanks for the Admiralty.

The Whitehead Iron and Steel Company, Limited, announce a final call on the partly-paid ordinary shares of 2s. 6d. per share, making £1 paid, payable March 1.

Herbert Greaves, Limited, have moved into new and more extensive premises at Houldsworth House, 35, Houldsworth Street, Newton Street, Manchester.

Bernard Holland & Company, 17, Victoria Street, S.W.1, are removing their air compressor department immediately to 15, 17, 19 and 21, Spenser Street, Victoria, S.W.

J. Blakeborough & Sons, Limited, have acquired from "Nuswift" (Bradford), the sole manufacturing and selling rights of the "Nuswift" patent fire extinguishers. The services of Mr. J. A. Goodall, the patentee, have been retained, and the business will in future be dealt with at the works of J. Blakeborough & Sons, Limited, Brighouse.

International Combustion, Limited, announce that S. A. Foyers Automatiques, Paris, have obtained the contract for the complete "Lopulco" installation to be installed at the Alost plant of the Société Générale de Soie Artificielle "Viscose." This order covers the supply of Raymond pulverising equipment, "Lopulco" hollow wall air-cooled combustion chambers with water screens, feeders, piping, burners and electrical equipment. The normal rating of the boilers is 14,000 kg. per hour, with a peak load rating of 18,000 kg. per hour.

Modern developments in steel manufacture, including the use of various alloys, were treated of in a paper which Mr. F. J. Stephens (at one time manager of the Knaben molybdenite mine in Norway) read before the Cornish Institute of Engineers at Camborne on February 19. Referring to uranium, he remarked that it was generally considered only in its form as a home of radium, yet ferro-uranium, introduced into steel in very small quantities, was one of the most satisfactory of the ferro-alloys. The use of these unusual minerals as ferro-alloys had by no means reached its fullest development.

Mr. O. G. Wight, presiding at the meeting of the North of England Iron, Steel and Metal Merchants at Middlesbrough, on Tuesday, stated that the past year certainly had been one in which the iron and steel trade had suffered severely along with the other industries of the country. Many firms of repute had been brought near to a final stoppage. The trouble had arisen over wages. He might say that nothing could possibly have been more likely to postpone wage increases than a stoppage of the kind through which industry had been passing. Businesses had to create new reserve funds, and were now in process of attempting to do so throughout the North of England. In the task they were absorbing profits which might otherwise have gone to increase wages.

In a circular to the shareholders, the chairman of Halley's Industrial Motors, Limited, states that in view of the proposals recently agreed to by the shareholders and creditors of the company it has been decided to proceed with the proposed reconstruction. A new company will be formed under the name of Halley Motors, Limited, or other appropriate name. Trade creditors of the company have agreed in principle to accept 5s. in the pound in cash and the balance of their claims in £1 fully-paid preference shares in the new company. Creditors for amounts not exceeding £20 have agreed to accept 10s. in the pound in cash. Holders of the eight per cent. notes have agreed to accept in settlement fully-paid preference shares to an amount equal to the amount of their claims. The company's bankers, the chairman states, who are large creditors on overdraft account, have agreed, subject to the reconstruction being effected, to extend the same facilities to the new as they did to the old company and to grant a moratorium in regard to interest for two years. Holders of ordinary shares in the old company will receive an equal number of shares in the new company of the nominal value of 6s. 8d., credited with 4s. 2d. paid up, leaving a liability of 2s. 6d., which will be payable in two instalments. It is also proposed that holders of ordinary shares allotted under the scheme will be granted an option for five years to take up on payment of 6s. 8d. per share one additional share for every two shares of the original allotment held. A special meeting will be convened to sanction the reconstruction.

Personal.

The late Sir Francis Fox, of the firm of Sir Douglas Fox & Partners, civil and consulting engineers, left £40,615.

Mr. John Hill has been re-elected for another three years as general secretary of the Boilermakers' and Iron Shipbuilders' Trade Union.

Mr. J. J. Warren, president of the Consolidated Mining and Smelting Company of Canada, has been elected a director of Henry Gardner & Company, Limited.

Mr. A. E. Howell, assistant manager of the Scotswood Locomotive Works of Sir W. G. Armstrong, Whitworth & Company, Limited, has been appointed to a position in connection with the Indian State railways at Calcutta.

Mr. W. H. Telfer has been elected managing director of the Coltness Iron Company, Limited, 75, Bothwell Street, Glasgow. Mr. Telfer has been general manager and a director of the company for the past three and a half years.

Mr. A. Spyer has been appointed general manager of Babcock & Wilcox, Limited, and Mr. C. S. Davy assistant general manager. An administrative committee has also been formed, consisting of heads of departments. The functions of the committee have not yet been finally decided upon.

Sir Charles E. Low, formerly Secretary to the Commerce and Industry Department of the Government of India, and a member during the war of the Indian Munitions Board, has been appointed to take charge of the Indian interests of the 14 engineering firms controlled by Agricultural and General Engineers, Limited.

Mr. S. S. Horsfield, for 25 years manager of the plate and angle mills of the Consett Iron Company, Limited, has been the recipient of a presentation from his workmen on the occasion of his retirement. Mr. R. Alsop, general secretary to the Consett Iron Company, presided, those present including Mr. F George, Mr. Horsfield's successor.

Colonel J. T. Moore-Brabazon, who was closely concerned with the passage of the Electricity Bill through Parliament last session, recently resigned his position at the Ministry of Transport in order to become chairman and managing director of the L. & N. Coal Distillation, Limited, the registration of which is announced this week. With Colonel Moore-Brabazon on the board are the following: Mr. Philip Tennant, chairman and managing director of Glico Petroleum, Limited; Colonel Vaughan Morgan, M.P., director and vice-chairman of Morgan Crucible Company, Limited; Mr. A. Woodeson, director, Clarke, Chapman & Company, Limited; Mr. Frank Middleton, deputy-chairman, Old Silkstone Collieries, Limited, and associated companies; Mr. Henry Ellison, director, Yorkshire Iron & Coal Company, Limited, and Major Bryan Laing, managing director, Sensible Heat Distillation, Limited.

Wills.

Rickerby, J., of Chatsworth Square, Carlisle, founder and late head of Rickerby, Limited	£35,773
Smith, F., of Danesleigh, Skipton Road, Keighley, of John Smith (Keighley), Limited	£6,872

Contracts Open.

Bridgend, March 7.—(11) 4,350 yards of 14-in. diameter cast-iron pipes, together with valves, etc.; (12) a cement concrete service reservoir, capacity 250,000 gallons; and 3,000 yards of 7-in. diameter and 670 yards of 6-in. diameter cast-iron pipes, for the Mid-Glamorgan Water Board. Messrs. Thomas & Morgan & Partners, engineers, Bridgend. (Fee £5 5s. for each contract, returnable.)

Cymmer, March 12.—Water and gas fittings and valves, and cast-iron pipes, from April 1, 1927, to March 31, 1928, for the Glyncorrwy U.D.C. The Council Offices, Cymmer, near Port Talbot.

Cymmer, March 12.—Galvanised tubes and fittings and lead from April 1, 1927, to March 31, 1928, for the Glyncorrwy Urban District Council. The Council Offices, Cymmer, near Port Talbot.

Stoke-on-Trent, March 7.—(7) Cast-iron work, for six months ending September 30, 1927, for the City Council. The City Surveyor, Town Hall, Stoke-on-Trent.

Littlehampton, March 8.—One 150-kw. Diesel engine and generator unit, complete with auxiliaries, switchgear and cables, for the Sussex Electricity Supply Company, Limited. The Secretary of the Company, 7, Hanover Square, London, W.1. (Fee, £2 2s., returnable.)

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IRON AND STEEL MARKETS.

Pig-Iron.

MIDDLESBROUGH.—Business on the Cleveland pig-iron market continues to be quiet. Deliveries are better, and prompt iron is obtainable with greater dispatch. Consumers, however, appear to be disinclined to commit themselves forward at current prices. They can afford to wait a little longer, and believe that by so doing they will obtain easier terms. Undoubtedly pig-iron values at present are very high, but there would seem to be little possibility of their reduction until such time as fuel can be bought more cheaply, and of that at the moment there is no sign. For, notwithstanding the recent coal settlement, coke producers are having to pay more for their coal than during the subsidy period. There is no change in the prompt price of East Coast mixed numbers, which remains quite firm at 90s. per ton. Makers, however, are willing to shade this figure for forward business, 89s. per ton being named. The position and outlook in Cumberland and North Lancashire are unchanged. While satisfaction is to be derived from the fact that the entire make of the sixteen furnaces blowing between Workington and Carnforth is going into consumption, and that orders are held that will enable smelters to keep their plants in operation for ten or more weeks to come, it is disappointing to find so little forward business being booked.

Metals.

Copper.—Generally a rather decided change of sentiment is noticeable in most non-ferrous metals, and this has resulted in slightly more buying in the copper market. This improvement is reflected in the foreign trade returns, and the belief that the present year will prove decidedly more prosperous than the last. Of course, the trade demand in this country, though fairly good, expands very slowly, and in face of the huge world production it is always argued that a sustained advance in values cannot be maintained.

Official closing prices of standard copper have been as follow :—

Cash: Thursday, £55 12s. 6d. to £55 15s.; Friday, £56 7s. 6d. to £56 10s.; Monday, £56 15s. to £56 17s. 6d.; Tuesday, £56 2s. 6d. to £56 5s.; Wednesday, £56 5s. to £56 7s. 6d.

Three Months: Thursday, £56 2s. 6d. to £56 5s.; Friday, £56 17s. 6d. to £57; Monday, £57 5s. to £57 7s. 6d.; Tuesday, £56 12s. 6d. to £56 15s.; Wednesday, £56 15s. to £56 17s. 6d.

Tin.—In regard to standard cash tin, intelligent anticipations of distinctly stringent conditions as regards supplies for the current month caused the market to be strongly supported throughout, and the feature was the rapid advance in the price of near tin. Three months' metal was bought actively over a certain period with the price rising, but then reacted on freer offers by importers whereby the backwardation on this position was increased in spite of strong Eastern cable advices.

Official closing prices of standard tin have been as under :—

Cash: Thursday, £311 5s. to £311 10s.; Friday, £314 15s. to £315; Monday, £315 to £315 5s.; Tuesday, £311 5s. to £311 10s.; Wednesday, £313 5s. to £313 15s.

Three Months: Thursday, £301 10s. to £301 15s.; Friday, £304 10s. to £304 15s.; Monday, £304 to £304 5s.; Tuesday, £299 to £299 5s.; Wednesday, £300 7s. 6d. to £300 12s. 6d.

Spelter.—Ordinary brands of spelter, in spite of the rather substantial increase in the American stocks for January, have gone ahead very well on active buying by dealers and consumers, and the outlook inspires more confidence. An important factor is the restriction of operations on the part of American ore producers, on account of the recent fall in values.

The following are the week's prices :—

Ordinary: Thursday, £30 12s. 6d.; Friday, £30 15s.; Monday, £31; Tuesday, £30 12s. 6d.; Wednesday, £30 15s.

Lead.—In regard to soft foreign lead, the market has been favourably influenced by the report that the principal American producer is curtailing production by 15 per cent., and consequently there has been some very good buying by consumers on the whole. The recovery in the demand for their products after a long period of comparative idleness has inspired more optimism in a market which had become very pessimistic regarding the future.

The week's prices are appended :—

Soft foreign (prompt): Thursday, £28 1s. 3d.; Friday, £28 2s. 6d.; Monday, £28 10s.; Tuesday, £28 8s. 9d.; Wednesday, £28 8s. 9d.

The Belgian Foundry Congress has been postponed from March 19 to April 9.

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